As I have had an occasion to remark (Ann. & Mag. nat. Hist., 1924, ser. 9, 14:92) *C. tatarica* is a species remarkable both for its very wide distribution area, comprising the whole of tropical Africa, southern Arabia and India, and for the great constancy of its characters which are not subject to any appreciable geographical variation. It is, therefore, particularly interesting to find a very clearly defined subspecies in Abyssinia, where it is obviously confined to highlands, since I have before me some specimens of the typical subspecies from the following localities in that country: Hawash station (*W. Thesiger*); between Hora Abjata and Hora Shala, circa 5,000 ft.; S.E. of Lake Zwai, circa 5,500 ft. (*J. Omer-Cooper*).

The acarine parasites of South African acridids, with special reference to the genus Podapolipus.

by

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This paper is the result of studies, carried out by the author, on the species of acarines parasitic on acridid locusts (Orthoptera) collected up to the time of the writing of this paper. No serious attempt has been made in South Africa to summarise our knowledge of these mites, with the exception of a short paper of a general nature, published in 1940 by Lawrence (1). In this paper, Lawrence's results have been extended and a full account of the South African members of the genus *Podapolipus* is given.

The author wishes to tender his grateful thanks to Dr. B. P. Uvarov of the Imperial Institute of Entomology and Mr. E. Browning of the British Museum for making tracings of drawings and copies of descriptions of *Podapolipus*, from journals not obtainable in South Africa. To Dr. R. F. Lawrence and Dr. S. F. Bush, both of Pietermaritzburg, the author owes much for their encouragement and the loan of apparatus.

Previous work on mites infesting locusts.

The mites which spend either a part or the whole of their existence on locusts and grasshoppers, belong to five distinct families — Trombidiidae, Erythraeidae, Tarsonemidae, Tyroglyphidae and Tydaeidae. In South Africa, all these families are represented, particularly the first two, and an interesting species belonging to the last named family has now come to light, making it the second member of its group to occur on an acridid host.

Trombid mites spend only the larval stages of their life-history attached to their host, the adults being free-living and predaceous. They are sometimes found in extremely large numbers attached to almost any position of their various hosts, and it is the opinion of some acarologists that they use the host for the purpose of distribution.

In this survey of locusts mites the first full account is given of the South African species of *Podapolipus*, which represents the only group of Tarsonemids as yet discovered on acridids in South Africa. Harris (2) has recently given an account of *Locustacarus locustae* Ewing, which occurs in East Africa in the tracheae of migratory locusts, and it is quite probable that these mites will also be discovered in the same situations in South Africa. The life history of a closely related American species, *Locustacarus trachealis* Ewing, has been studied by Wehrle and Welch, who showed that it is pathogenic and causes inconvenience to the host. Harris, however, does not believe that *L. locustae* Ewing will prove to be of great economic importance when fuller investigations have been carried out on its life history. According to him the laying powers of the host do not appear to be impaired. Unfortunately, however, no serious attempt has been made to study in full the bionomics of this mite, which may prove to be an interesting parasite. As Uvarov says, referring to *L. trachealis*, "the obstruction of the tracheae and air-sacs must seriously interfere with normal respiration and affect the general activities of the insect".

The Tyroglyphidae are represented by *Caloglyphus julidicolus* which Lawrence (1) discovered in vast numbers on both male and female individuals of the African migratory locust, *Locusta migratoria migratorioides* R & F. He discusses this species rather fully and adds that the presence of these mites on locusts is probably adventitious.

An interesting record was sent in to the Natal Museum recently by the Union Department of Agriculture in which it was stated that certain mites closely resembling *Caloglyphus julidicolus* Lawrence, were damaging locust eggs. Uvarov (3) emphasizes the importance of mites, which he does not name, as enemies of locust eggs in Russia; he quotes an unpublished report of Miss A. A. Popova who states that up to 30-40 per cent. of the eggs may be destroyed by mites in the U.S.S.R.

A new record for South Africa, is the discovery of a mite, belonging to the family Tydaeidae. This acarine was taken in fair numbers on *Cyrtacanthacris lineata* Stoll. by the author in October 1939 at the Natal Herbarium, Durban. As far as can be ascertained, only one species belonging to this family has previously been described. This was *Proctotydaeus viator* Ber. which occurs on the wings of *Acrididus parvulus* in Java. After careful consideration of Berlese's description of the genus, the author has decided to place the South African species in the genus *Proctotydaeus*, of

which it probably represents a new species. The mite occurs in all stages, egg, larva, and adult on the body of the host, and is visible to the naked eye, being brick red in colour. A fully developed adult measures 587 μ long and 291 μ broad. These acarines were found in association with *Podapolipus locustanus* n.sp. on which they possibly preyed. Tragardh (4) has described a Trombid mite *Pimeliaphilus podapoliphagus* Trag. from North Africa which lives under the elytra of a beetle *Pimelia*, together with a species of *Podapolipus* on which it preys. The species of *Proctotydaeus* has well developed mouth-parts, suited to a predaceous mode of life. Unfortunately too few specimens of the mites were obtained to permit the carrying out of bionomic investigations. As the mouth-parts are slender it is improbable that they would be used to obtain nourishment from the locust, protected as it is by a thick chitinised exoskeleton.

The known species of the genus *Podapolipus*.

P. reconditus . . . . Rov. et Grassi. 1888. Bull. Soc. Ent. Ital. Bd. 20. p. 59. Insects, Italy.

P. grassii . . . . . Berlese. 1900. Gli Acari Agrarii. Rev. di Pat. Veg. Vol. 8. pp. 227-297. On *Locusta migratoria*. Italy.

P. berlesei . . . . . Lahille 1907. On *Schistocerca*. Argentine.

P. apodus . . . . . Tragardh 1904. Res. Swed. Exped. Egypt & White Nile. N. 20. p. 108. Egypt. On beetle *Pimelia*.

P. batocerae . . . . Berlese. 1910. Redia, 6. p. 270. Java. On *Batocera hectoris* (Coleoptera).

P. bacillus . . . . . Berlese. 1911. Redia. 7. p. 434. Java. On *Bacillus* (Phasmidae).

P. aharonii . . . . . Hirst. 1921. P.ZS. 1921. p. 800. Fig. 41. Palestine. On acridid *Tropidopola longicornis* Fieb.

P. komareki . . . . Storkan. 1927. Zool. Anz. 71. p. 21. *On Hylobius abietus* (Coleoptera).

No description of *P. berlesei* Lahille was published, only some figures. Unfortunately the figures accompanying the descriptions of *P. reconditus* R. & G. and *P. grassii* Ber. were poorly executed, but it is possible to use them for purposes of identification. The reproduction of such diagrams, however, as for example in Uvarov's work on locusts and grasshoppers, has unfortunately led to some confusion.

Podapolipus grassii Berlese (1900). Fig. 3.

Larva. Slightly larger than *P. solitarius* n.sp. and smaller than *P. locustanus* n.sp. Body oval in shape. Mounted specimens transparent, living specimens white to transparent. In this respect it differs from the other South African species, which are a light amber.

The capitulum very broad and dome shaped, no division between the gnathosoma and idiosoma. The palps almost indistinguishable, with two pairs of small setae. A short distance behind

the point of origin of the palps, rising laterally, a pair of longer setae. Dorsally on the cephalothorax two pairs of short hairs. Further back on the cephalothoracic shield towards its posterior margin, two very long setae. On the anal segment of the dorsal aspect two pairs of hairs of moderate length, situated laterally. On each side of the long caudal setae, a pair of short spines, and on the underside of the opisthosoma situated posteriorly, two small flattened setae. Ventro-laterally on the second segment a pair of very fine setae.

Legs II and III terminating in suckers, leg I in a sucking pad, and provided with a number of fine hairs. Segment IV with two long hairs — one situated laterally, the other dorsally. Tarsus II with two long setae, III dorsally with a long seta.

Length 183 μ; breadth 124 μ.

Male. No appreciable difference in size between *P. grassii* Ber. and *P. locustanus* n.sp. The body oval in shape. Mounted specimens transparent. The division between cephalothorax and abdomen present, and as in the case of the larva, the body divided into three segments.

Capitulum roughly the shape of a Grenadier's busby, its contour broken anteriorly by the styliform mandibles. The palps cannot be distinguished. On the cephalothoracic shield placed anteriorly a pair of short setae, and situated near to the posterior margin two very long setae, dorso-laterally on the second segment two very long conspicuous setae. The male organ, which is dorsal and well forward in the median line, clearly visible and papilliform in outline. It is however not as clearly defined as that figured by Rovelli and Grassi for *P. reconditus* R. et G. Ventrally on the propodosoma two short hairs. In addition, on the ventral side of the abdomen, a pair of hairs slightly longer than those of the cephalothorax. Unfortunately in Berlese's figures these setae have been shown longer than they actually are.

Leg I and II relatively short and stout, tapering rather rapidly. Leg I shorter than II. Leg II and III with distinct suckers. Leg I with a small sucking pad. Tarsus II with a long hair and tibia II with a shorter hair. Tarsus III with 3 strong spines proximally, one ventral, one lateral and one ventro-lateral. Tarsus III with 2 very long setae arising dorsally, one distally and one proximally and terminating in three very powerful spines.

Length 184 μ; breadth 125 μ.

Female. Body contour broken by a slight V-shaped indentation at the posterior end. The division between cephalothorax and abdomen not visible in specimens before me. Leg I short and apparently not bearing hairs as in *P. locustanus* n.sp. First segment with a well formed claw and at its base apparently a little tubercle or process. Dorsally on segment II a strong spine. The second pair of legs reduced at their apices to two large rounded bifurcated processes as shown in figure. Leg II in *P. grassii* Ber. more diffe-

rentiated than that of *P. locustanus* n.sp. Capitulum distinctly differentiated from the rest of the body and chitinised. The styliform mandibles distinct, the palps free. The capitulum elongated, papilliform, and broader anteriorly than posteriorly.

All specimens examined carried a number of eggs attached to the posterior region of the body, by a mucilaginous substance. Within these eggs developing embryos were found. The greatest number of eggs attached to a full grown female was 14. Young females usually with two or three eggs.

Hosts: *Locusta migratoria migratorioides* R. & F.; **Morphacris fasciatus* Thunb.; **Pseudochirista* spp.

Locality: Two adult female and five adult male examples of *L.m. migratorioides* R. & F., infested with large numbers of these mites were submitted by Prof. J. C. Faure, Director of Locust Research in Pretoria, for study. The other hosts were collected in Durban by the author in December, 1940.

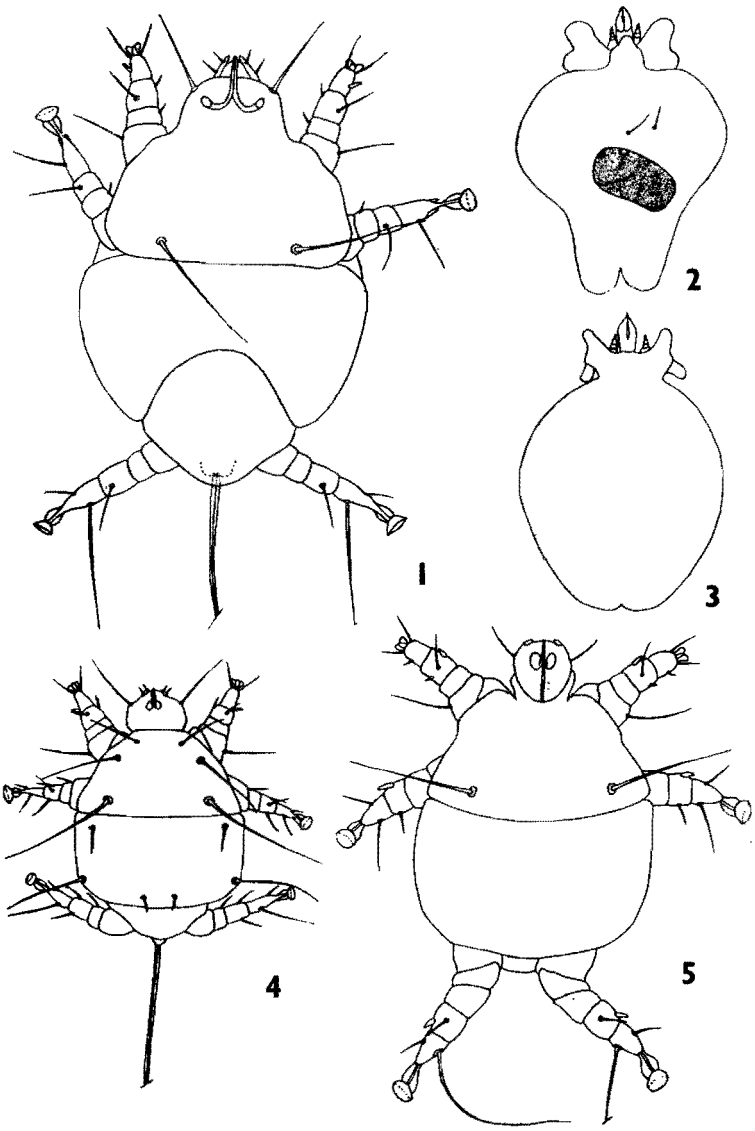
Podapolipus locustanus n.sp. Figs. 1, 2 and 5.

Larva: (Fig. 1). The larva of this species is very large and more heavily chitinised than those of the other South African species. It is approximately of the same size as the male. Unlike the examples of *P. grassii* Ber., it is amber in colour. Mounted specimens oval in shape. A clear division between cephalothorax and abdomen. The palps relatively stout and bearing two pairs of small setae situated laterally, the proximal pair the stouter of the two. The distal pair apparently dorsal in origin, the proximal pair lateral. The styliform mandibles distinctly visible and comparatively strong. Just posterior to the base of the palps, and rising ventrally, a pair of small setae. In no other South African species are the mouth parts so well developed. In this respect, to a certain extent, it resembles *P. solitarius* n.sp.

Dorso-laterally on the cephalothoracic shield and situated posteriorly, a pair of long setae. Ventrally and anteriorly, a pair of short hairs. Unfortunately, in all the specimens before me, the anal region was obscured by foreign matter and the arrangement of the setae could not be studied.

Legs short, II and III (which is the longest) bearing distinct bell-shaped suckers. Leg I with a sucking pad and with a number of setae as shown in figure I. Dorsal surface of tarsus I with a strong, short, sensory seta known as a clavate hair. It is situated dorso-laterally near the proximal end of the tarsus, and is about two-fifths the length of the segment, being relatively much smaller than that of *P. solitarius* n.sp. Dorsal surface of tibia I with a long seta, a similar dorso-lateral seta on segment IV. At the base of the sucker a rudimentary claw which can be easily distinguished. Tarsus III with a very long dorsal seta. Otherwise the arrangement

*For the identification of these two hosts the cordial thanks of the writer are due to Dr. A. J. Hesse of the South African Museum, Cape Town.



Podapolipus locustanus n.sp.
Fig. 1.—Larva, dorsal surface.
2.—Female, dorsal surface.
5.—Male, dorsal surface.

Podapolipus grassii Berlese.
Fig. 3.—Female, dorsal surface.

Podapolipus solitarius n.sp.
Fig. 4.—Larva, dorsal surface.

of hairs as shown in figure I. The long caudal setae the only hairs on the posterior margin of the opisthosoma.

Length 245 μ; breadth 171 μ.

Male: (Fig. 5). Mounted specimens ovate in shape, the broadest portion situated posteriorly, approximately the same size as the male of *P. grassii* Ber. Mounted specimens amber in colour and strongly chitinised. Division between cephalothorax and abdomen not very distinct. On the cephalothorax two long dorsal setae, dorso-laterally on segment II a pair of very small setae.

Rostrum ovate, the broadest portion situated anteriorly, distinctly separated from cephalothorax. The fold beneath the capitulum distinctly visible. The palps which are short and thick, clearly visible, their ventral surfaces with a pair of posteriorly situated setae. Laterally the capitulum with a pair of prominent setae. The styliform mandibles short and easily distinguishable, more darkly pigmented than the surrounding structures.

The legs relatively longer than those of *P. grassii* Ber., III slightly longer than II. Leg II and III provided with very conspicuous suckers but I with only a small sucking pad. The male of this species characterised by having all the tibiae provided laterally with a strong spine. Tibia I in addition with a smaller ventro-lateral spine. Tarsus II with a very long seta, and tibia III with two long ventral setae. Dorso-laterally tarsus I with a small clavate hair, about half the length of tarsus. The fourth segment of leg I, tarsus II, and the dorsal surface of tibia I, all with a long seta.

The fold beneath the capitulum, which is characteristic of these mites, present and clearly visible. The male organ of reproduction difficult to distinguish on account of foreign matter obscuring the dorsal aspect of the two available specimens.

Length 184 μ; breadth 139 μ.

Female: (Fig. 2). The female of this species strongly pyriform in shape, the broadest region anteriorly, narrowing rapidly in the opisthosomatic region. Posteriorly the body bifurcates.

In one of the two specimens examined a line of division between cephalothorax and abdomen is present. In a dorso-median position, close to the division between cephalothorax and abdomen, two very short hairs. Cephalothorax with appendages and a distinct capitulum, which is elongated. The anterior pair of legs minute and segmented, with a well formed claw and three short setae. In addition a dorsal clavate hair about half the length of the tarsus. In *P. grassii* Ber. there is a minute process opposite the claw.

The second pair of legs reduced to a pair of smooth swelling processes which are divided into two short "fingers". In *P. grassii* Ber. the second pair of legs is similar but more strongly developed, while those figured for *P. aharonii* Hirst are relatively much smaller. The palps distinct and free. The styliform mandibles

strong and the capitulum oblong papilliform. The tubercle bearing the stigmal orifice, which is situated above the first leg, small, resembling that of *P. aharonii* Hirst.

The eggs relatively large, apparently not retained within the body for any length of time, as has been asserted in the case of other *Podapolipus* spp. They are expelled to the exterior and adhere to the body of the parent by a mucilaginous secretion. Twenty-three and twenty-nine eggs were attached to the two females examined. In each case there was a fully formed egg within the body and a number of hatched eggs within the mucilage. Embryo larvae were present in a few of the eggs. This species appears to be nearest to *P. solitarius* n.sp. Host. *Cyrtacanthacris lineata* Stoll.

Locality. Type specimens taken from two hosts at the Natal Herbarium, Durban

Podapolipus solitarius n.sp. Fig. 4.

Larva: (Fig. 4). Smaller than *P. grassii* Ber. and *P. locustanus* n.sp., which it resembles. The mounted specimen very pale amber in colour and not as strongly chitinised as *P. locustanus*. The sides of the body parallel, its anterior and posterior apices roughly truncate. The idiosoma divisible into three segments, the anterior longest, the second broadest, the third concave anteriorly.

The mouthparts well developed, the capitulum strong, truncate, with a pair of lateral setae, as is found in *P. locustanus* n.sp. The palps resembling those of *P. locustanus*, the setae arranged in much the same way. The styliform mandibles easily distinguished, being darkly pigmented. The fold beneath the rostrum, peculiar to this group, not clearly seen, but more in evidence than in the case of *P. grassii* Ber.

Dorso-laterally and towards the posterior margin of the cephalothoracic shield, two very long fine setae. In almost the same position or the second segment but placed more laterally, a pair of similar but shorter setae. Dorsally and arising anteriorly, two pairs of long setae. In addition situated anteriorly and dorso-laterally a pair of small hairs. In this species the dorsal setae appear to be relatively longer than those of *P. locustanus*. On the ventral surface of the propodosoma a pair of small setae and on the same segments situated posteriorly an additional similar pair. On the ventral aspect of the opisthosomatic segment and situated anteriorly, a pair of short hairs.

The legs short, I and II (which are more or less equal in length) slightly shorter than leg III, tarsus III laterally with a long seta, tibia II with a similar seta. The spinose hair on tarsus I proximal and equal in length to this segment. It is very strong and relatively larger than that of *P. locustanus* n.sp. This species is nearest to *Podapolipus grassii* Ber.

Length 155 μ; breadth 103 μ.

Host: *Morphacris fasciatus* Thunb. Described from a single specimen collected in Durban, October 1939, by the author.

Key to the known males and larvae of the South African species of Podapolipus.

1. Males and larvae with only one pair of long conspicuous setae on the cephalothoracic shield 2
   Larvae with three pairs of conspicuous setae on cephalothoracic shield. Long pair postero-laterally on abdomen . *solitarius* n.sp.
2. Male with a pair of short setae placed anteriorly on the cephalothoracic shield. Tibia I, II and III of male without spines. Male and larva subhyaline . . . . . *grassii* Ber.
   Mouthparts strong. Tibia I, II and III of male with strong spine. Male and larva amber . . . . . *locustanus* n.sp.

General considerations on the genus Podapolipus.

The species of *Podapolipus* enjoy a wide distribution, occurring in five continents. The genus appears to favour the warmer regions of the world, being found in the temperate and tropical countries. Most species are found on acridid hosts but some of them also occur on Phasmids and Coleoptera. All the species are parasitic.

Faure in a footnote to Lawrence's paper (1) says that as far as he is aware *Podapolipus grassii* Ber. produces no ill effects on the host. Long observation by the author on the parasitism of *Morphacris fasciatus* Thunb. and *Pseudochirista* spp. in Durban by the same mite, induces him to draw a similar conclusion. A large number of these grasshoppers were collected on a patch of ground 12 feet by 18 feet and every individual examined was infested with *P. grassii* Ber. Though other species of acridids lived on the same patch of ground apparently none were infested. The hosts of *P. grassii* Ber. and *P. locustanus* n.sp. showed no pathological symptoms and field observations revealed no diminution of their saltatorial or flying powers.

In Lawrence's recent paper the first mention is made of the appearance of the genus *Podapolipus* in South Africa. He discusses at some length *P. grassii* Ber. which he found under the wings of the host. He states that females and larvae were very numerous, adult males comparatively rare. The writer has come to the same conclusion while investigating species of *Podapolipus* collected by him. In the case of *P. grassii* Ber. great numbers of larvae and females were found but only an occasional male. As regards *P. locustanus* n.sp., the larvae were numerous while the females occured sparingly. Only two males were discovered. *P. solitarius* n.sp. is represented by a single larva.

Among the females of *P. locustanus* n.sp. a number of young forms in the transitional stage between larva and adult were found. The females while beginning to enlarge still bore certain larval characteristics, such as the caudal setae, and the second and third

legs showed signs of atrophy. In a number of them, however, an egg could be seen through the body wall. This is an interesting fact in view of previous investigations by the author (5) on a mite *Hemitarsonemus latus* (Banks) belonging to the same family. It was suggested in that paper that the female is fertilised by the male before she reaches maturity and evidence was given in support of this suggestion. It would appear that this aspect of the life history of *P. locustanus* n.sp. would repay investigation and might be found to exhibit a close resemblance to the corresponding phase of the life-history of *H. latus* (Banks).

Summary.

In this paper an attempt is made to give a summarised account of our knowledge of the locust infesting acari of South Africa A record is given of a form of *Proctotydaeus*, occurring on a South African acridid and the opinion is expressed that it may prove to be a new species. A full account of the known South African species of *Podapolipus* follows, together with a general consideration of the genus.

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Studies on South African Thysanoptera — II.

by

C. JACOT-GUILLARMOD.

The types of all new species described in this paper are in the author's collection. The figures were drawn by the author with the aid of a camera lucida.

Chirothrips hoodi sp.n. (Figs. 1 and 2).

Female (macropterous). Length about 1.2 mm. General colour yellowish brown. Head brown with a very slight tinge of yellow; the entire thorax and abdomen paler and more distinctly tinged